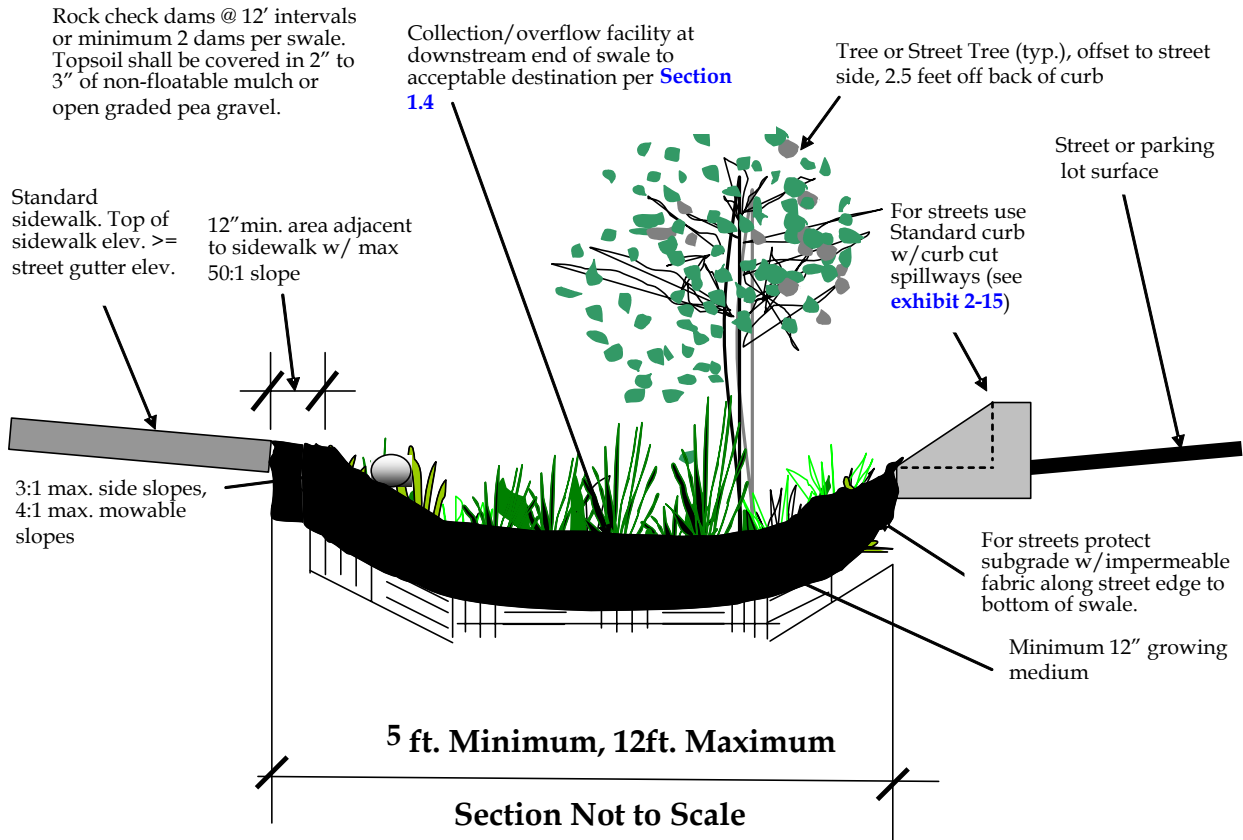


Swales

Vegetated Swale



Stormwater Management Goals Achieved Acceptable Sizing Methodologies

√ Pollution Reduction.....	SIM, PRES ¹
Flow Control.....	NA
Destination.....	NA

This facility is **not** classified as an Underground Injection Control structure (UIC).

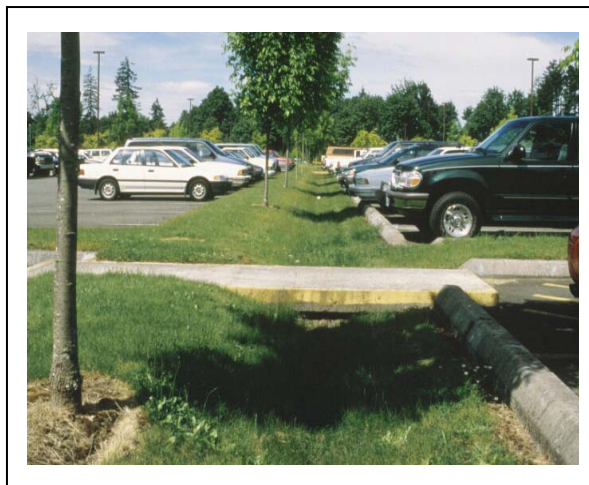
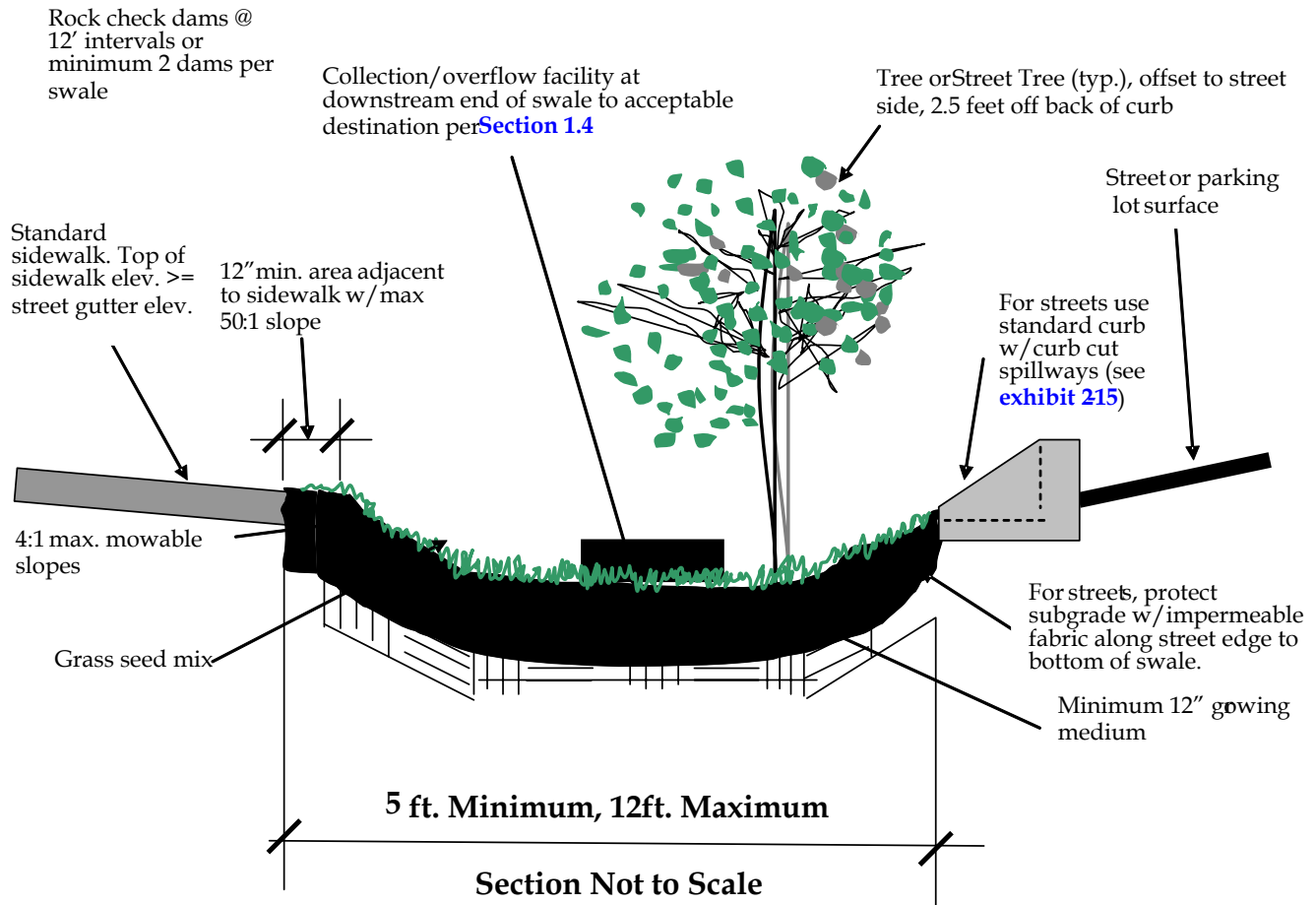
SIM=Simplified Approach, PRES= Presumptive Approach

Notes: Swales can be used to manage runoff from parking lots, rooftops, and private streets.

1) Projects greater than 15,000 square-feet of impervious area to manage must use the Presumptive Approach to size the swale for pollution reduction, additional facilities will be required to meet flow control requirements when applicable.

Swales

Grassy Swale



Swales

Description: Swales are long and narrow landscaped depressions used to collect and convey stormwater runoff, allowing pollutants to settle and filter out as the water flows from one bay to the next through the facility. Swales should be integrated into the overall site design and can be used to help fulfill a site's required landscaping area requirement. An approved collection/overflow method per Section 1.4 will be required at the end of the swale, unless the swale is designed as a surface infiltration facility per destination criteria presented in **Section 1.4** using the Presumptive Approach presented in **Section 2.2**.

Design Considerations: When designing swales, slopes and depth should be kept as mild as possible to avoid safety risks, improve aesthetics, and prevent erosion within the facility. For street swales in the public right-of-way all applicable City requirements for other street elements (curbs, sidewalks, trees, etc.) must be met. Swales located next to public sidewalks shall have a minimum 12"-wide flat area between the swale and the sidewalk.

Construction Considerations: Swale areas should be clearly marked before site work begins to avoid soil disturbance and compaction during construction.

Design Requirements:

Soil Suitability: Swales are appropriate for all soil types. Topsoil shall be used within the top 12 inches of the facility, or the soil shall be amended per **Appendix G** to support plant growth.

Dimensions and Slopes: Facility storage depth may vary 4 to 12 inches. Maximum side slopes are 3 horizontal to 1 vertical for vegetated swales, and 4 horizontal to 1 vertical for grassy swales (to accommodate for mowing). Minimum flat bottom width is 2 feet for private swales and public swales within the planter strip of the right of way and 4 feet for all other public swales. The maximum bottom width is 8 feet. Maximum longitudinal slope is 6%, while minimum slope is 0.5%. Maximum surrounding ground slopes shall be 10%. Temporary erosion control measures will be required on slopes greater than 2%, to stabilize soils until sufficient vegetative growth is established. To minimize flow channelization, the swale bottom shall be level, with a uniform longitudinal slope.

Flow spreader: The swale shall incorporate a flow-spreading device at the inlet to the swale. The flow spreader shall provide a uniform flow distribution across the swale bottom. Private swales may use riprap to disperse the flow from the inlet pipe. In swales with a bottom width greater than 6 feet, a flow spreader shall be installed at least every 50 feet.

Flow inputs: All stormwater entering the swale during the Water Quality Design Storm shall have a minimum residence time of 9 minutes. When the SIM method of sizing is used, the input or inputs into the swale shall be at the upstream end and no other inputs (such as curb cuts or downspout connections) shall enter the swale without a minimum residence time calculation.

Access routes: Access routes to the swale for maintenance purposes must be shown on the plans. Public swales require a minimum 10-foot wide access route for maintenance, not to exceed 10 percent in slope.

Swales

Setbacks: Required setback from building foundations is 10 feet unless lined with impermeable fabric. Easements for non-buildable areas on adjacent properties may be required if facilities are located next to property lines.

Sizing: Swales sized with the Simplified Approach shall be designed to receive less than 15,000 square-feet of impervious area runoff. For these projects, a Simplified Approach sizing factor of 0.05 for vegetated swales and 0.06 for grassy swales may be used to receive credit for pollution reduction. Swales with greater than 15,000 square feet of impervious area to manage must use the Presumptive Approach to size the swale for pollution reduction, and additional facilities will be required to meet flow control requirements, where applicable. A high-flow by-pass mechanism will not be required in these cases, but a high-flow overflow must be provided at the downstream end of the swale to an approved destination point, per **Section 1.4**.

Presumptive Approach Sizing Criteria:

- 1) **Pollution Reduction Criteria:** The swale width and profile shall be designed to convey runoff from the Water Quality Design Storm (intensity is 0.22 inches/hour for on-line facilities and 0.13 inches/hour for off-line facilities) and shall meet the following criteria:
 - Maximum flow depth during the Water Quality Design Storm is 4 inches.
 - Maximum water velocity during the Water Quality Design Storm is 0.9 feet per second.
 - Minimum hydraulic residence time (time for Q_{design} to pass through the swale) of 9 minutes.
 - Minimum longitudinal slope of 0.5 percent, maximum slope of 6 percent. For slopes greater than 2 percent, check dams shall be used (one dam every 12 feet).
 - Designed using a Manning "n" value of 0.25 for grassy swales and 0.35 for vegetated swales.
- 2) **Flood Control Criteria:** On-line pollution reduction swale facilities shall be designed to convey runoff from the Flood Control Design Storm and shall meet the following criteria:
 - Maximum flow depth is 12 inches.
 - Maximum water velocity through the facility shall not exceed 3 feet per second (fps) during the Flood Control Design Storm.
 - The swale design shall include a high-flow by pass mechanism or be sized to safely convey the 25-year storm event, analyzed using the Rational Method (peak 25-year, 5 minute intensity = 3.5 inches per hour).
- 3) Vegetation or grass cover shall be established as soon as possible after the swale is completed, and before water is allowed to enter the facility.
- 4) Unless vegetation or grass cover is established, biodegradable erosion control matting appropriate for low-velocity flows (approximately 1 foot per second) shall be installed in the flow area of the swale before allowing water to flow through the swale.

Swales

Check Dams: Check dams shall be constructed of durable, non-toxic materials such as rock, brick, or concrete, or soil by integrated them into the grading of the swale. Check dams shall be 12 inches in length, by the width of the swale, by 2 to 5 inches in height.

Landscaping:

Vegetated Swales

Vegetation provides filtration and root uptake functions, protects from rain and wind erosion, and enhances aesthetic conditions. The “facility area” is equivalent to the area of the swale, including bottom and side slopes, as calculated from Form SIM. Turf grass may be used to cover the entire swale surface area. If plantings are chosen to landscape the swale, the minimum plant material quantities per 100 square feet of facility area shall be as follows:

- 2* - Large shrubs/small trees: 3-gallon containers or equivalent.
- 6 - Shrubs/large grass-like plants: 1-gallon containers or equivalent

Ground cover plants: 1 per 18 inches on center, triangular spacing, for the ground cover planting area only, unless seed or sod is specified. Minimum container: 4-inch pot. At least 50 percent of the groundcover plantings shall be grasses or grass-like plants.

*No large shrubs or small trees shall be planted in street swales, in lieu of 2 large shrubs/small trees 8 shrubs/large grass-like plants shall be planted.

Wildflowers, native grasses, and ground covers used for City-maintained facilities shall be designed not to require mowing. Where mowing cannot be avoided, facilities shall be designed to require mowing no more than once annually.

Topsoil in vegetated swale shall be covered in non-floatable mulch or open graded pea gravel.

Grassy Swales

For the swale flow path, approved native grass mixes are preferable and may be substituted for standard swale seed mix. Seed shall be applied at the rates specified by the supplier. The applicant shall have plants established at the time of facility completion (at least 3 months after seeding). No runoff shall be allowed to flow in the swale until grass is established. Trees and shrubs may be allowed in the flow path within swales if the swale exceeds the minimum length and widths specified.

Native wildflowers, grasses, and ground covers used for City-maintained facilities shall be designed not to require mowing. Where mowing cannot be avoided, facilities shall be designed to require mowing no more than once or twice annually. Turf and lawn areas are not allowed in City-maintained facilities without specific City approval.

Swales

Trees: The following evergreen or deciduous trees shall be retained or planted within or adjacent to the swale and continuing approximately 30 feet on center the length of the swale:

Evergreen trees:	Minimum height: 6 feet
Deciduous trees:	Minimum caliper: 1 ½ inches at 6 inches above base.

Recommended street trees in or near street swales:

With overhead power lines

Acer campestre ‘Evelyn’
 Carpinus caroliniana
 Cercis Canadensis
 Gleditsia triacanthos ‘Impcole’
 Koelreuteria paniculata

Without overhead power lines

Betula jacquemontii
 Celtis occidentalis
 Fraxinus pennsylvanica ‘Johnson’
 Gleditsia triacanthos ‘Skycole’
 Nyssa sylvatica
 Quercus shumardii

Stormwater Report Requirements For Presumptive Approach: See Exhibit 2-2.

Checklist of minimal information to be shown on the permit drawings:

- 1) Facility dimensions and setbacks from property lines and structures
- 2) Profile view of facility, including typical cross-sections with dimensions
- 3) Growing medium specification
- 4) Filter fabric specification (if applicable)
- 5) All curb cut details and stormwater piping associated with the facility, including pipe materials, sizes, slopes, and invert elevations at every bend or connection
- 6) Landscaping plan

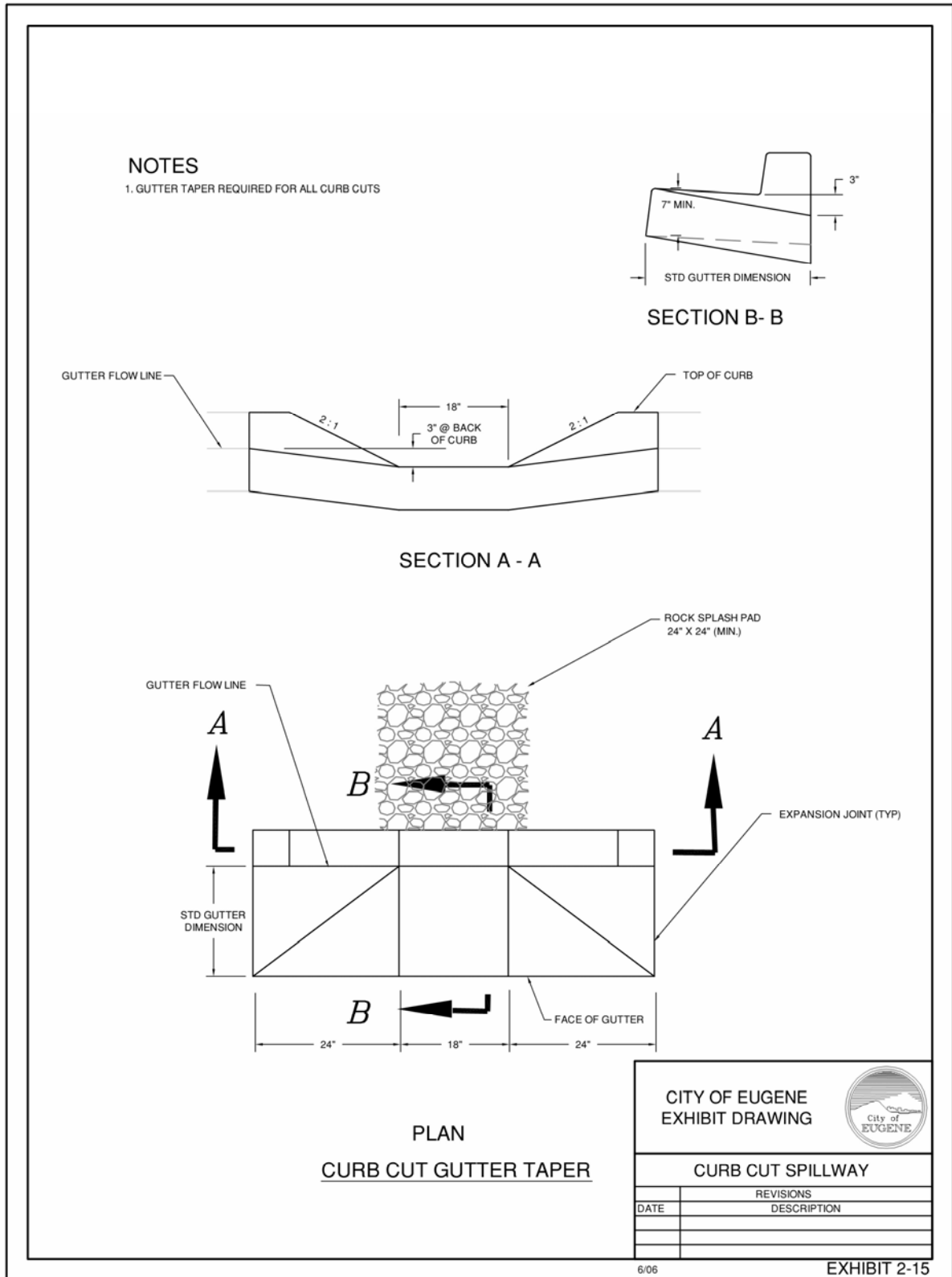
Inspection requirements and schedule: The following table shall be used to determine which stormwater facility components require City inspection, and when the inspection shall be requested:

Facility Component	Inspection Requirement
Swale grading	
Curbs / curb cuts	Call for inspection
Piping (if applicable)	Call for inspection
Filter fabric (if applicable)	
Growing medium	
Plantings/seeding/sod	Call for inspection

Operations and Maintenance requirements: See Chapter 3.0.

Swales

Exhibit 2-15: Curb Cut Spillway



Swales

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